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ABSTRACT

A study explored students' dynamic use of various forms of reading and writing to learn. In investigating the relationship between learner initiative, literacy, and the ability to conduct a critical inquiry of a topic of study, seven college undergraduates were asked to direct their own reading and writing engagements enroute to composing a persuasive essay. The main sources of data for the analyses were video-taped work sessions, think-aloud protocols, persuasive essays that the students produced, and students' responses to the debriefing interviews. Analysis of students' think-aloud protocols and debriefing interviews indicated that the reasoning in which students were involved, and how reasoning changed across the task, was a complex phenomenon mediated by both specific reading and writing engagements and the purposes for which these activities were undertaken. Results of the debriefing interviews, in conjunction with the think-aloud protocols and students' essays, revealed that an individual learner was capable of creating a kind of vicarious community of readers and writers exchanging different topical perspectives with one another as they moved back and forth between writing notes, reading articles, writing the essay, reading the essay, and reading their notes. Findings suggest that in order to foster students' ability to inform themselves about topics of study, ways of helping them begin to direct their own reading and writing activities in order to learn need to be explored. (Five figures and 11 tables of data are included, and 61 references are attached.) (Author/MG)

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CENTER FOR THE STUDY OF READING

Technical Report No. 477

THE EFFECTS OF READING AND WRITING UPON THINKING AND LEARNING

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Abstract

This study explores students' *dynamic use* of various forms of reading and writing to learn. In investigating the relationship between *learner-initiative*, *literacy*, and the ability to conduct a *critical inquiry* of a topic of study, seven college undergraduates were permitted to direct their own reading and writing engagements enroute to learning and composing a persuasive essay. Analysis of students' think-aloud protocols and debriefing interviews indicated that the *reasoning* in which students were involved, and how it changed across the task, is a complex phenomenon mediated by both specific reading and writing engagements and the *purposes* for which these activities were undertaken. Across students various forms of reading and writing proved to be very versatile activities, each providing students with the means to fulfill a number of different purposes. Results of the debriefing interviews in conjunction with the think-aloud protocols and students' essays revealed that an individual learner was capable of creating, through his or her own recursive engagements, a kind of *vicarious community* of readers and writers exchanging different topical perspectives with one another as they moved back and forth between writing notes, reading articles, writing their essay, reading the essay, and reading their notes. One implication for research is that if we wish to more fully understand the combinatorial power of reading and writing upon learning and thinking dialectically, we must examine students' ability to direct their own reading and writing exchanges across a particular task. In terms of instruction, this study suggests that if we want to foster students' ability to *inform* themselves about topics of study, we must explore ways of helping them to begin directing their own reading and writing activities in order to learn.

THE EFFECTS OF READING AND WRITING UPON THINKING AND LEARNING

> A writer is not so much someone who has something to say as he is someone who has found a process that will bring about new things he would not have thought of if he had not started to say them.
>
> William Stafford (1977)

A principal tenet of recent theories in the area of writing is the belief that writing actually engenders understanding by virtue of the exploration and re-examination of ideas that it affords (Applebee, 1984; Emig, 1977; Gage, 1986; Nostrand, 1979; Nystrand, 1977; Perl, 1979; VanDe Weghe, 1987; Vygotsky, 1962; Luria & Yudovich, 1971). Recent instructional reforms have advocated the improvement of writing instruction as a means to improve the thinking and reasoning ability of students in academic subjects. These reforms, often referred to as "writing across the curriculum," originate with the belief that the kind of writing students do in school has a direct influence on the quality of thinking in which they are required to engage (Applebee, 1981; Fulweiler & Young, 1982; Gage, 1986; Gere, 1985; Langer & Applebee, 1986; Martin, 1975; Mayher, Lester, & Pradl, 1983; Newkirk & Atwell, 1982).

The act of reading on the other hand, while traditionally understood as a means of learning, has historically been viewed as a receptive, text-centered process of abstracting the author's meaning from the text. However, in light of recent empirical developments in cognitive psychology, readers have been described as performing a series of more cognitively engaged activities analogous to evolving a schema (Anderson & Pearson, 1984); composing meaning (Tierney & Pearson, 1984; building and revising a model of the text (Collins, Larkin, & Brown, 1980); developing envisionments (Langer, 1986a; 1986b); generating relations between the text and one's experience (Linden & Wittrock, 1981; Wittrock, 1984); testing and evaluating hypotheses (Rumelhart, 1984); enriching, meaning based on context-relevant prior knowledge (Spiro, 1980).

As a corollary of these views, both educators and theorists from a wide range of academic disciplines have expressed concern over the need to begin fostering students' ability to *think critically* about issues and topics of study (Ennis, 1987; Giroux, 1988; McPeck, 1981; Smith, 1988; Tchudi, 1988). In the area of literacy and literacy education, proponents of this view have emphasized the role of schooling in the development of students' "critical literacy," or more specifically, their ability to use reading and writing in ways that exceed those uses often associated with minimum competency (Friere, 1982; Giroux, 1988; Katz, 1982; Walters, Daniell, & Trachsel, 1987). Indeed, the comment offered by a recent panel of United States educators about the use of reading and writing in the study of biology underscores this relationship between reading and writing and the development of a kind of *critical intelligence*. As the panel concurred:

> A learner is only a partial biologist, for instance, if he cannot read or write to discover information and meaning in biology. When a student takes the results of his or her observations about lobsters, reads, writes a draft, talks, reads, then writes again, he or she learns what it is to think critically. (Guthrie, 1986, p. 15)

Other theorists have stressed the relationship between learner-initiative or student empowerment and the ability to use reading and writing to think dialectically in conducting a thorough topical inquiry (Giroux, 1988; McGinley & Tierney, 1988; O'Flahavan & Tierney, in press). Giroux, for example, advocates a redefinition of the pedagogy of both writing and critical thinking arguing that "any approach to critical thinking, regardless of how progressive it might be, will vitiate its own possibilities if it operates out of a web of classroom social relations that are authoritatively hierarchical and promote passitivity, docility, and silence" on the part of students (p. 64). Similarly, in their recent chapter on reading, writing, and thinking, O'Flahavan and Tierney (in press) explore the dependencies which underly this connection between literacy, student initiative, and fostering critical thinking.

Empirical tests of the effects of writing on thinking and learning from texts, have demonstrated that writing in conjunction with reading results in learning or understanding not achieved when either reading or writing are undertaken alone (Colvin-Murphy, 1986; Copeland, in press; Langer & Applebee, 1988; McGinley & Denner, 1987; Tierney, Soter, O'Flahavan, & McGinley, in press). In addition, a group of related studies suggests that while extended forms of writing (e.g., analytical or personal essays) in combination with reading result in a more thorough understanding of topics in both literature and the social sciences, various types of writing (e.g., analytical, formal, and personal essays, notes, summaries, and answers to study questions) resulted in uniquely different patterns of reasoning and different types of learning (Durst, 1987; Langer & Applebee, 1988; Marshall, 1987; Newell, 1984; Tierney, Soter, O'Flahavan, & McGinley, in press).

Nevertheless, this class of important contemporary approaches to understanding the influence of reading and writing upon thinking and learning have several interrelated limitations concerning our understanding of the dependencies which underlie *literacy*, *student-initiative*, and the development of a *critical intelligence*. In general, these limitations stem from the use of experimental approaches which have involved giving students a *prescription* of reading and writing engagements through which to think and learn about topics. In general, by restricting or prescribing the diversity of the reading and writing exchanges in which students are permitted to engage or by simply not *examining* such learner-initiated exchanges, these studies provide a somewhat limited picture of how students might use more complex combinations of reading and writing enroute to thinking and learning. O'Flahavan and Tierney (in press) conceive of these more complex reading and writing combinations as "higher-order juxtapositions" that are engendered by instructional settings which sanction and promote learner-initiative and self-direction.

The present study is derived from the theoretical position that when students are involved in directing their own reading and writing activities (writing notes, reading articles, writing a draft, reading notes, reading a draft, making an outline, etc.) in pursuit of some other learning, they are able to avail themselves of the different perspectives and ways of thinking that more *elaborate* combinations of these activities will permit. While this research specifies the topic and the rhetorical problem that students are to address, it does not constrain the process or manner in which students are to read, write, take notes, formulate questions, reread, or revise previous drafts as part of learning. Although it is limited in scope to a content domain which lends itself to this type of critical analysis, this investigation employed a case-study approach in order to address three broader questions which underlie the relationship between literacy, self-direction, and the ability to conduct a thorough inquiry of a topic:

1. What purposes do different forms of reading and writing serve as students use them in order to learn, and what is the nature of the thinking which underlies students' decisions to shift from one form of reading or writing to another across a task?

2. What is the relationship between students' purposes, the specific forms of reading and writing in which they elect to engage, and the reasoning operations they ultimately engage in over the course of a given learning activity?

3. How is students' ability to direct their own reading and writing across a task reflected in their overall progress toward their goal as evidenced by changes in the patterns of their reasoning over time, the emergence of conceptual insights or breakthroughs, and the quality of their written products?

METHOD

In gathering data on the thinking and learning that results from various reading and writing engagements, a number of resources were used to provide a rich and multifaceted data base. The main sources of data for the analyses were the video-taped work sessions, the think-aloud protocols, the persuasive essays that students produced, and students' responses to the debriefing interviews. The information obtained from all four of these sources served as supporting sources of evidence of the thinking and learning that each of the case study students engaged in during their combined reading and writing activities.

Subjects

The subjects for this research consisted of seven college undergraduate education majors of junior or senior standing from the University of Illinois, Champaign-Urbana. Although participation in the study was voluntary, students wishing to take part were reimbursed for their time and cooperation.

Materials

Two informational articles which address the topic of mandatory drug testing in the workplace were selected from among 14 similar articles that were randomly chosen from a range of current popular periodicals.

During the process of selecting articles, several criteria served to guide the researcher in choosing appropriate reading material. First, of the two articles which were selected, each contained an approximately equal number of words (800-1000) and presented a clear and thorough discussion of both sides of this complex issue. Second, both articles appeared in periodicals of comparable journalist quality (i.e., *U. S. News & World Report* and *Business Week*). In addition to validating the appropriateness of the articles in a pilot experiment, a colleague verified the comparability of the essays with regard to the presentation of arguments pertinent to both sides of the issue. Once the two articles were completely decided upon, they were to be duplicated and placed in a folder labeled "The Library" which was then made available as a potential resource for the subjects in the experiment.

Procedures/Task

This study permitted students to engage in various types of reading and writing activities enroute to learning and formulating a persuasive essay. The data in the investigation was collected over a two-week period, with the researcher meeting with each student individually for one session lasting for approximately two or three hours. This session also included a 20-minute training period during which time students were given an opportunity to practice the technique of thinking aloud during reading and writing. Students were then presented with a written explanation and description of the topic they were to study and of the specific task they were to complete. The topic explanation and task description read as follows:

> As part of your participation in this study, I would like you to work on composing a persuasive essay or commentary. In writing this essay, I urge you to work on composing a responsible, informative, and persuasive piece that (a) presents *both sides* of the issue, and (b) develops and *supports* your own views of the topic, and (c) seeks to convince others of validity of your position. For your commentary on an issue, please address the issue of *mandatory drug testing in the workplace*. If it helps you to envision an audience, you may think of me as a magazine editor who will read and review your essay. Please consider the two attached articles as sources of information on the topic should you need them.

At this time, copies of the two resource articles on the topic were made available for their use. Students were informed that they could engage in whatever reading or writing they felt was necessary in order to complete the task, and they were given as much time as they needed to study the material in order to compose a satisfactory essay during a single session. Students were instructed to complete a draft which would be in a form suitable for typing. Finally, they were informed in advance that upon completion of their essay they would be asked to respond in writing to a series of interview questions regarding the activities in which they were engaged.

Analysis of Think-Aloud Protocols

Upon completion of their reading and writing tasks, each subject's protocol was transcribed and then segmented into separate thought units (Hunt, 1965). Hunt's T-units contain a main clause and any subordinate clauses attached to it. However, because of the pauses and false starts characteristic of self-reports, thought units were not always grammatical sentences. Each thought unit in each student's protocol was analyzed along the following five dimensions: (a) the time at which each thought unit

occurred across the task, (b) reasoning operation, (c) discourse purpose, (d) discourse mode (reading, writing, or free thinking), and (e) discourse form (notes, draft, map, article, etc.).

Time

Each thought unit was categorized according to the time segmented in which it occurred from the beginning to the end of the task. This permitted an examination of how students' thought processes changed across the task as a result of their *combined* reading and writing engagements. These time segments were later collapsed into four time periods each representing an equal proportion of a given subject's total working time. The decision to study students' thinking and learning over four separate time periods was made in order to examine the way in which different *combinations* of reading and writing influenced thinking throughout the task as opposed to intentionally focussing on those moments when one particular activity was dominant. Four time periods produced the most balanced distribution of think-aloud comments.

Reasoning Operations

In order to determine the effects of different engagements in reading and writing upon students' thinking processes and their purposes for undertaking these activities, a detailed system of codification and analysis was adapted from Langer's (1984; 1986) Analysis of Meaning Construction. Reasoning operations and discourse purposes (see next section) respectively refer to *what* cognitive operations a student engaged in and *why* they engaged in them. For example, a student may at some point be involved in *hypothesizing* (reasoning operation) in order to *formulate* ideas (discourse purpose) (e.g., "I'm trying to develop their argument and I think at the same time I'm thinking how I'm gonna go against their argument"). The sub-categories of reasoning operations represent a modified version of the scheme used by Langer and Applebee (1987). The sub-category "restating content" was added in order to distinguish between restatements of passage content and other comments reflecting reasoning operations (Durst, 1987). All categories were mutually exclusive. Categories of the eight reasoning operations are defined and explained below.

Categories and Examples of Reasoning Operations

Questioning - Uncertainties and incomplete ideas the person has at any point in developing the piece --related to genre, content, or text. May include both low and higher level questions.

> *"I'm not sure how much drug testing costs." "I'm not where I stand." "What about drug testing for workers whose jobs directly affect public safety such as airline pilots, train crews, etc."*

Hypothesizing - Plans, choices, suppositions or predictions the writer makes at the point of utterance, including choice of words, or predictions the reader makes about what the genre is about, what the function of a particular piece of text is, or about the answer to a question, based on that specific portion of the text. Includes hypotheses made about the past, present, or future.

> *"I guess all the bad things decreased and productivity rose." "I need to come up with something that's clearer about the two sides." "I know that I want to develop the idea of having MDT as part of rehabilitation and for the ethic of society."*

Making Metacomments - Comments about the reader or writer's use or non-use of particular structural or content (ideas) information.

> *"I'm gonna put in brackets, the invasion of privacy." "I put we instead of them." "I'm rereading the first part."*

Using Schema - Comments reflecting the readers' or writer's use of knowledge to formulate, evaluate, develop or explain their own ideas, concepts, or arguments. May include synthesizing, generalizing, classifying, or relating content to personal knowledge. Extending beyond the text.

"Ok tests should be sensitive to employees but not rely solely on tests." "I think companies need to show a more ethical obligation to society."

Paraphrasing - Comments which reflect attempts to reformulate, or paraphrase the ideas, concepts, or arguments of the author.

"They feel that--they stress that drugs affect a person's performance and that employers have a right to make sure that employees are performing at the top level." "This says that drug testing invades the privacy of the innocent."

Citing Evidence - The information the writer presents, the explanations the writer provides, or the evidence the writer develops to answer a question, carry out a hypothesis, or support a new idea an argument. Or, the information the reader gathers or explanations the reader provides to answer a question, or to confirm a hypothesis. Includes all statements of direct causality. May include restatements of the actual text or the student's written draft.

"They said tests are accurate and reliable." "Here it is, safety related jobs--pilots, bus drivers, nuclear plant operators." "Another pro would be for a safer society."

Validating - The information (implied or direct) that the plan, goal, or supposition was fulfilled or a decision made.

"I feel good, like I'm getting somewhere." "Alright, that's enough on that side." "I thought he was contradicting himself." "So this article is against drug testing." "I agree that if they don't want to take the tests they don't have to."

Restatements - Rereadings from the actual resource texts or the student's written draft, notes, outline etc., unless they are rereading as part of citing evidence.

"Drug testing affects both the user and non-user alike." "The drug wars will be won with treatment not tests."

Two raters, the researcher and a graduate student, each scored approximately 800 thought units from a randomly selected protocol. Disagreements between the raters were discussed and resolved in favor of one or the other rater. This permitted more specific information concerning the percentage of rater agreement by category. The inter-scorer percentage agreement by category was as follows: Questioning (97.8), Hypothesizing (85.1), Metacomments (97.8), Using Schema (83.1), Paraphrasing (100.0), Citing Evidence (83.1), Validating (87.5), and Restating Content (87.5). Total percentage agreement across categories was 90.1%.

Knowledge/Cognitive Change

Information from the think-aloud protocols also served as an important source of evidence concerning the cognitive change that students underwent as a result of their combined reading and writing engagements across the task. In order to examine these changes in students' thinking, both quantitative and qualitative methods of analysis were used. Examination of students' protocols for changes in thinking and evidence of conceptual insights or breakthroughs were made on the basis of verbal cues or direct evidence in the student's self-report (e.g., "I think I've finally got this now. I realize that this is no longer just a pro-con issue; it's more complicated than that.").

In order to further understand how the reasoning patterns of the two select students differed as a result of their combined reading and writing engagements over time, a lag sequential analysis was conducted using the data from the think-aloud protocols. Lag sequential analysis, initially proposed by (Bradbury & Fincham, 1986) has served as a valuable complement to long-linear analysis in the study of social

interaction. Similar to log-linear analysis, lag sequential analysis permits the study of sequential dependencies among coded behaviors, thereby preserving the dynamic quality of interpersonal exchanges. In addition, in both analysis statements of statistical significance are based upon comparisons between observed and expected values. However, in lag-sequential analysis, the expected values (unconditional probabilities) are subtracted from the observed values (conditional probabilities) and this difference is divided by an error term to produce a statistic resembling a Z-score as opposed to a likelihood ratio statistic as in long-linear analysis. Lag sequential also permits the examination of longer sequences of behavior. Specifically, his analysis provided information with respect to the following questions: (a) given that a certain reasoning operation has occurred at a particular time across the task, what are the most likely forms of reasoning to follow? and (b) do students differ with respect to the probabilities of certain types of reasoning occurring across time periods?

Discourse Purpose

Langer's (1986) instrument for analyzing the strategies students used in making meaning was reconceptualized to reflect the *purposes* that different forms of reading and writing served across the task. Categories of discourse purposes are defined and explained below.

Categories and Examples of Discourse Purposes

Generate - Engaging in forms of reading and writing at various points across the task in order to generate new ideas, concepts, opinions, or questions.

> *"I was thinking maybe I'm only for it if it's up to the individual companies." "I think companies need to show a more ethical obligation towards society."*

Formulate/Refine - Engaging in forms of reading or writing at various points across the task in order to develop a particular message or argument. This may involve considering the audience, drawing on personal experience, choosing language, linking concepts, summarizing, and paraphrasing.

> *"I want to do something that the issue shouldn't be whether it is mandatory or not but why we should have it in the first place." "I'm ready to come up with something that says there are two factions." "How can I say that it is not only MDT but MDT with a mandatory rehabilitation program?"*

Analyze - Engaging in forms of reading and writing at various points across the task in order to analyze or examine the meaning that is being developed. May involve reviewing, reacting, or monitoring the development of the message itself.

> *"I'm feeling a little confused about how I feel." "I don't think I have a clear-cut view anymore."*

Revise - Engaging in forms of reading or writing at various points across the task in order to alter or change the original message. May involve reconsidering and restructuring the message, knowing meaning has broken down, and taking appropriate action.

> *"So I probably won't include that." "Individual in this sense refers to the user and non-user alike." "I think I'm gonna eliminate that last part."*

Plan/Organize - Engaging in forms of reading or writing at various points across the task in order to plan or organize.

> *"So I have to find out more . . . find out more of what it does involve." "Ok, I think I might try to read more before I take notes." "I'm gonna put that as some facts for the pro."*

Acquire/Update - Engaging in forms of reading and writing in order to gather or acquire new or relevant information. May involve reading any relevant portion of the text(s).

"Equally important, merely testing people for drugs is not likely to solve drug abuse in the workplace." "I didn't know that drug and alcohol addiction afflicted 13 to 15% of the workforce and that was in 1983."

Evaluate - Engaging in forms of reading and writing at various points across the task in order to evaluate the meaning that is being developed. Making comments which reflect the value or worth of particular ideas.

"What good does testing do?" "That's a contradiction of the quote about the American way." "That's a good way to say it." "That is a selfish reason to do the testing."

Review - May involve reading the text(s) or rereading the student's own draft in order to simply review or "rehear" the ideas or flow of the message being developed.

"The policy which is far to all people is the Equal Rights Policy."

Inter-scorer percentage agreement by category was as follows: Generate (85.7), Formulate (81.6), Analyze (80.7), Revise (100.0), Plan/Organize (95.1), Evaluate (89.4), Review (100). Total percentage agreement across categories was 86.8%.

Discourse Mode

Discourse mode distinguishes between those portions of the think-aloud which were reported while the subject was engaged in either reading, writing, or free thinking. Accordingly, each thought unit in the think-aloud protocol was coded as occurring during one of these three activities. This information was obtained by reviewing a video tape of each subject as they engaged in reading and writing, and then matching each transcribed thought unit with the students' corresponding discourse mode. Two raters, the researcher and a graduate student, rated approximately 800 thought units. Inter-scorer percentage agreement for discourse mode was 88.0%. In those cases in which correspondence between thought units and discourse mode was especially difficult, a joint decision was made by the researcher and the other judge concerning the scoring of the unit in question.

Discourse Form

In combination with discourse mode, discourse form distinguishes between those portions of the think-aloud which were reported while the subject was engaged in different forms of reading or writing (e.g., writing notes, reading notes, writing a draft, reading a draft, or reading a text, etc.) enroute to learning. This information was obtained by reviewing a video tape of each subject as they engaged in reading and writing, and then matching each transcribed thought unit with the students' corresponding discourse form. Inter-scorer percentage agreement for discourse form was 90.9. Again, in those cases in which correspondence between a communication unit and discourse form was especially difficult, a joint decision was made by the researcher and the other judge.

Analysis of Debriefing Interviews

Discourse Purpose

A modified version of the debriefing interview originally developed by Tierney, Soter, O'Flahavan, and McGinley (in press) was used to further examine students' reading, writing, and learning. Students were asked to respond in writing to a series of questions designed to help them think about how different reading and writing behaviors helped them to reach a more thorough understanding of the important issues concerning the topic of study. The first section of questions was designed to explore each student's perceptions of the purposes that various reading and writing engagements served as they prepared to write their essay. Still other questions provided information concerning students' decisions to engage in different forms of reading or writing at different points across the task.

Topical Knowledge

Two additional questions asked students to reflect on the extent to which they had heard, thought, or read about the topic, as well as comment on their level of interest in the topic. As such, this portion of the interview served to clarify and extend similar data obtained from the *discourse purpose* analysis of each student's think-aloud protocol.

Knowledge/Cognitive Change

The second portion of the debriefing interview contained two questions designed to capture students' perceptions about how their knowledge or thinking about the topic changed or remained the same from the beginning to the end of the task. For example, one question asked students to reflect on how their knowledge of the topic changed or remained the same as a result of the reading and writing that they undertook. The second question asked that students describe any specific points across the task during which they experienced a conceptual breakthrough or insight into the important issues surrounding the topic.

Qualitative Analysis of Persuasive Essays

The essays of two of the case study students, Lisa, and Kathy, were examined for additional evidence of conceptual insights or breakthroughs which occurred as a result of their reading or writing. The identification of these insights in the essays of these two students was done by examining their essays in conjunction with both their think-aloud protocols and responses to those questions in the debriefing interview which asked that students describe any such conceptual breakthroughs. The intent of this analysis was to identify moments of conceptual insight and then examine how such insights were engineered and then articulated in the students' essays.

RESULTS

Processes and Purpose

Analysis of the think-aloud protocols provided four perspectives from which to examine the nature of students' reading, writing, and learning as they attempted to formulate their essays: (a) the specific reading-writing behaviors in which they engaged; (b) the reasoning operations they employed; (c) the purposes served by different forms of reading and writing; and (d) the interrelationship between students' purposes across the task, their choice of reading-writing engagements, and their reasoning operations. In addition, the written debriefing interviews were meant to provide a sense of students' own perceptions of the activities in which they engaged.

Specific Reading and Writing Engagements

The percentage of specific reading and writing activities in which each student engaged across the task are presented in Table 1. Examination of the central tendency across students indicates that on the average a greater proportion of thinking, as evidenced by the number of thought units, was reported while students were involved in reading the resource articles (43.8%), writing the draft of their essay (28.6%), and reading their own written draft (15.0%). This last finding is consistent with other theoretical work which has identified the act of reading one's own writing as an important component of the composing process (Murray, 1982; Pearson & Tierney, 1984; Tierney, Leys, & Rogers, 1984).

[Insert Table 1 about here.]

Table 2 contains the percentage, combined across students, of thought units that occurred during various reading and writing engagements from the beginning to the end of the activity. There was considerable variation in the specific types of reading and writing activities that students chose to engage in at various times across the entire task as well as considerable change in the diversity of those engagements. For instance, in the initial stages of their learning (time 1), a majority of students' thought units concerning

the topic occurred while they were reading the resource articles (86.6%) in combination with a relatively small proportion of thought units while writing notes (12.0%). However, in subsequent stages of the task students tended to enlist a relatively more balanced combination of reading and writing forms with which to think and learn about the topic as evidenced in the second time period. As indicated by the percentage of thought units, these forms included writing the essay (40.1%), reading the resource texts (23.3%), reading their written draft (15.5%), writing notes (10.7%), and reading their own notes (9.2%).

[Insert Table 2 about here.]

Reasoning Operations During Reading and Writing

Table 3 contains the percentages of each reasoning operation used by individual students across all of their reading and writing engagements. Inspection of this table reveals that more than one-half of the thought units which accompanied students' reading, writing, and learning across the task involved *using schema* (24.7%), *metacommenting* (16.9%), and *questioning* (15.9%). However, there was considerable variation between students in the remaining five categories of reasoning operations. The most notable of which was the percentage of restating, where the difference between two students ranged from 2.1% to 19.0%. For explanations and descriptions of individual reasoning operations see the previous section on the analysis of think-aloud protocols, *Categories and Examples of Reasoning Operations*.

[Insert Table 3 about here.]

Table 4 provides a sense of how reasoning operations, combined across students, varied across four equal periods of time from the beginning to the end of the task. Interestingly, with the exception of the first period of time when *using schema* (29.5%) and questioning (18.5%) accounted for the greatest proportion of students' reasoning, *metacommenting* and *using schema* tended to be the most dominant form of reasoning in each of the three remaining time periods. On the surface such a result would appear to be problematic since it would suggest that, as a group, students' thinking varied little across the entire task in spite of the diverse forms of reading and writing in which they engaged.

However, the data also reveal several noteworthy, albeit subtle, changes in the *patterns* of students' reasoning over time. As students progressed toward completion of the task, the proportion of *metacommenting*, *restating*, and *validating* tended to increase in the following manner from time 1 to time 4: *metacommenting* (9.0% to 29.7%), *restating* (4.7% to 19.3%), and *validating* (3.4% to 7.1%). Meanwhile, the proportion of *paraphrasing*, *questioning*, and *hypothesizing*, tended to decrease from beginning to end of the task as follows: *paraphrasing* (18.2% to 5.7%), *questioning* (18.5% to 8.0%), and *hypothesizing* (10.9% to 7.0%) indicating that as the task neared completion students' reasoning reflected a parallel of development--characterized by less *questioning* and *hypothesizing* and more *validating*, *metacommenting*, and *restating*.

[Insert Table 4 about here.]

Purposes for Reading and Writing

The proportion of thought units associated with the purposes for which each student engaged in various forms of reading and writing throughout the task are presented in Table 5. An examination of the general tendency across students indicates that approximately 50% of the reading and writing that students undertook was done so that they might *analyze* ideas (19.6%), *formulate* ideas (17.3%), and *plan and organize* ideas (16.3%). However, results also indicate that the percentage of thought units associated with the purposes that reading and writing served, varied considerably across students. For instance, analysis of one student's protocol (Pam) indicated that 14.9% of the reading and writing in which she engaged was done in order to *generate* her own ideas enroute to completing the task. This same student engaged in a relatively small proportion (7.4%) of reading and writing in order to *update* and *acquire* ideas or information on the topic. By comparison, a second student (Wanda) who did little reading or writing in order to *generate* ideas (6.5%), engaged in a much larger proportion of reading and writing (22.5%) in order to *update* and *acquire* information on the topic. For explanations and descriptions of purposes associated with different reading and writing activities see the previous section on the analysis of think-aloud protocols, *Categories and Examples of Discourse Purposes*.

[Insert Table 5 about here.]

Table 6 provides a sense of how students' purposes, varied over four equal periods of time from the beginning to the end of the task. An examination of this table reveals several important patterns of change in students' purposes as evidenced by the proportion of thought units in each time period. For instance, as students progressed toward completion of the task (time 1 to time 4) an increasingly smaller proportion of the types of reading and writing that they chose to engage in were done in order to *generate* (23.9% to 1.0%), *analyze* (23.9% to 12.3%), *update-acquire* (23.0% to 3.7%), and *evaluate ideas* (17.1% to 8.3%). On the other hand, as the task grew toward its completion, the percentage of thought units indicates that students tended to engage more in reading and writing which enabled them to *formulate* (0.7% to 34.3%), *revise* (0.1% to 9.7%), and *review* ideas (1.0% to 16.3%) from time 1 to time 4 respectively.

[Insert Table 6 about here.]

The Relationship Between Purpose, Engagements, and Reasoning

Purpose and engagements. The interrelationship between students' reading and writing engagements and variety of purposes they served are portrayed in Figure 1. This figure contains a total of five *relational clusters*, each comprised of a specific engagement (displayed in box), and the proportions of thought units associated with the different purposes for which they were undertaken. Only those purposes which, in combination, account for at least 50% of all possible purposes are presented. For example, note that as students read notes, at least 50% of their thinking was associated with the need to *plan-organize* (35.5%) and *analyze* (23.4%).

Figure 1 illustrates the way in which a single reading or writing activity may serve a number of different purposes. Results suggest that the most versatile activity students engaged in was reading the texts, which they did in order to *update-acquire* (26.2%), *analyze* (24.3%), *generate* ideas (18.5%), and *evaluate* ideas (15.4%). Results also indicate that an equally multi-purposed activity was that of writing notes, which students tended to use largely in order to *plan-organize* (40.2%) but also in order to *generate* (22.5%), and *analyze* ideas (17.7%).

[Insert Figure 1 about here.]

Engagements and reasoning. Figure 2 depicts the proportion of different reasoning operations which occurred during specific reading and writing activities. In spite of some similarities across forms of reading and writing, this figure suggests that students were involved in different patterns of reasoning as they moved from one type of engagement to another. For example, as students read the resource texts, a large proportion of their thought units indicated that they were involved in *using schema* (using their own ideas as they reacted to the texts) (26.4%), *paraphrasing* the texts (18.3%), and *questioning* the material (17.5%). While reading their notes, students engaged in a somewhat different pattern of reasoning operations, using schema to a lesser extent (15.9%), and engaging in proportionally more *questioning* (28.0%), and *hypothesizing* (17.8%). Finally, as students read their essays, they were involved in *restating* content from the texts themselves (42.3%) and making *metacomments* about the usefulness of particular pieces of information (20.6%). Examination of students' thought units as they wrote the draft of their essay and wrote notes reveals additional differences in reasoning. In writing their essay students were engaged in *using schema* (34.1%), making *metacomments* (24.3%), and *questioning* (14.4%). However, in writing notes students' reasoning centered on *citing evidence* in support of their beliefs (20.1%), *hypothesizing* (20.1%), and *questioning* (17.7%).

[Insert Figure 2 about here.]

Purpose, engagements, and reasoning. The clusters in Figure 3 provide a sense of the relational structure which exists between purpose, reading and writing engagements, and reasoning operations. This figure contains a total of eight clusters, each comprised of a purpose or goal, the proportions of thought units associated with the specific reading or writing activities students engaged in enroute to

fulfilling that purpose, and the percentage of thought units associated with the reasoning operations that students were involved in as a function of a particular purpose and engagement.

Figure 3 indicates that as students engaged in reading the resource texts, their patterns of reasoning tended to vary in accordance with the underlying purpose or goal of that reading. This tendency is reflected in students' reasoning operations as they engaged in reading the texts for a variety of purposes, the most significant of which were to *update-acquire* (26.2%), *analyze* (24.3%) and *generate* (18.5%) (see Figure 2). When reading the texts served as a vehicle with which to *update-acquire* ideas, students' reasoning was most often characterized by *paraphrasing* (45.3%) and *restating* (22.6%). However, when students read the texts in order to analyze ideas, they were more involved in *questioning* (42.9%) and *using schema* (23.7%). Finally, while reading the texts in order to *generate* ideas, more than one half of the reasoning that students did was characterized as *using schema* (57.8%) and *hypothesizing* (17.3%). To a lesser extent, other purposes which reading the texts served, and the reasoning operations most frequently associated with them were to *evaluate* (*using schema*, 51.3% and *paraphrasing* 22.5%), and *plan-organize* (*metacommenting* 55.5% and *hypothesizing* 18.9%).

The influence of purpose upon reasoning is also evident as students engaged in writing the essay. Figure 3 indicates that when writing the essay served as vehicle with which to *formulate* ideas, students' reasoning was most often characterized by using *schema* (51.8%) and *questioning* (13.0%). However, efforts to *plan-organize* while writing the draft resulted in large proportions of *metacommenting* (46.0%) and *hypothesizing* (38.0%).

[Insert Figure 3 about here.]

The Debriefing Interviews

Questions from the debriefing interview provided four different types of information concerning students' reading, writing, and learning throughout the course of the task: (a) evidence of their previous knowledge and interest in the topic prior to participating in the study; (b) the purposes that specific forms of reading and writing served during the task; (c) the reasons underlying students' decisions to shift from one form of reading or writing to another at different points across the task; and (d) the extent to which students experienced major conceptual insights or breakthroughs during their reading and writing. Information from the interviews both corroborates and extends previous findings from the protocol analysis.

Prior Knowledge of the Topic

Careful examination of students' debriefing responses revealed that only two of the seven students indicated having developed either strong feelings or a position for or against mandatory drug testing prior to their participation in the project. The response of one of those students reflects this disposition. As she explained:

> *I have thought about drug testing a lot because it affects me directly I did feel strongly about the efficacy of drug tests in the workplace. While I did not radically state my views on tv or in the newspapers, my views were fairly well grounded and changed very little if someone asked me to state my views. (Pam)*

However, while the responses of this and another student indicated that they had given the topic some serious thought, six of the seven subjects indicated that their main source of information on the topic was in the form of a few brief television "news clips." One student indicated having read about drug testing in the *Chicago Tribune*.

Purposes for Reading and Writing

Examination of the debriefing responses across students indicates that the specific forms of reading and writing in which they engaged served a variety of unique yet partially overlapping purposes. Students reported that reading the resource texts helped bring the important issues to their attention and provided them with the means to *acquire* and then *analyze* relevant information concerning arguments both for and against drug testing. As excerpts from the writing of several students illustrate:

> *Reading the articles gave me information upon which to base my view. (Pam)*
>
> *Reading the articles helped me to form a more detailed idea of what is involved in the whole issue of drug testing, the different opinions. (Sara)*
>
> *Reading the articles presented me with both the pros and cons of mandatory drug testing, giving me ideas I had not previously considered. (Wanda)*

Likewise, as reported earlier, analysis of students' protocols indicated that they frequently read the articles in order to *update-acquire* (26.2%) and *analyze* (24.3%) ideas (see Table 7). However, the following response by a fourth student both highlights some of the variation between subjects, while at the same time illustrating how the activity of reading the texts served as a means to *acquire* the ideas of others as well as to *generate* one's own ideas. As this student explained:

> *The articles gave me concrete information about the issues. This helped me formalize my viewpoint and gave me ideas about specific concerns. (Dawn)*

The previous comment also parallels findings from the protocol analysis which revealed that 18.5% of students' thought units during reading the articles were associated with an effort to *generate* ideas.

[Insert Table 7 about here.]

On the other hand, students' comments about writing the essay indicated that this activity served a number of different purposes, the most notable of which was helping students to *plan*, *organize*, and *formulate* their own views or thoughts on the topic. This also reflects earlier findings which revealed that writing the essay was most often associated with students' attempts to *formulate* (49.3%) and *plan-organize* (18.9%) ideas. As the following examples of responses indicate, students frequently credit writing the essay with helping them to "find words for their thoughts," to "think through" or to "see" what they really thought about the topical issues. Excerpts from the responses of several students indicate how writing the essay helped students to *analyze*, *organize*, and *formulate* their own thinking:

> *Writing a draft helped me to organize my thoughts. It forced me to find words for what I was thinking and what my opinion was. (Nina)*
>
> *Writing the essay made me incorporate the ideas of the articles. I had to restate the ideas, both pro and con, and form a hypothesis. (Dawn)*
>
> *Writing helped me decide which points were important and which ones were not. (Sara)*
>
> *It (writing the essay) helped me think through what I actually thought on the issue. It helped me make decisions and take a stand on the issue. (Kathy)*

Students' responses about writing notes revealed that this activity was used for a somewhat different set of purposes than either reading the resource texts or writing the essay. However, much like reading the texts and writing the draft, writing notes was used for a variety of purposes. As the following examples of written comments indicate, students frequently link writing notes with helping them to "separate their ideas into categories," and "come up with reasons" to support their arguments, and to "refer to" during the essay. Excerpts from the responses of several students reveal how writing notes provided them with the means to *plan* and *organize*, *generate*, and *analyze* both their ideas and the ideas of others:

Writing notes helped me organize what I was thinking. It also forced me to come up with reasons to support both sides (of the argument). (Nina)

This helped me more clearly see the issues and the complexities involved in drug testing. (Kathy)

I think especially writing down the pros and cons helped in that my writing revolved around those main ideas and I referred to them almost every time I wrote something in the essay. (Sara)

Again, these comments concerning the purposes which students attach to writing notes corroborate previous trends from the protocol analysis which indicated that students often used this activity in order to *generate* (22.5%) and *plan-organize* ideas (40.2%).

In much the same way, results from students' think-aloud protocols, which revealed that reading notes helped them to *plan-organize* (35.5%) and *analyze* ideas (23.4%), were also reflected in their debriefing comments. As the following responses reveal, students frequently credit their notes with helping them to "stick to their focus," and giving them direction when they were "stuck" or unsure where to direct their thinking. Excerpts from the responses of several students indicate how reading their notes helped them to maintain momentum, by providing a means with which they could periodically *plan* and *organize* as well as *analyze* the direction of their ideas and arguments:

My notes served as a base to keep going back to for support in the body of the paper. (Sara)

This helped me remember my original thoughts and ideas and helped me to stick to my focus and not get off track. (Kathy)

Reading (notes) brings the details back to mind. I read (notes) to find the details that support my ideas. (Dawn)

Finally, students reported that reading their own essay helped them to "keep the paper and words flowing" as well as "make sure I agreed with what I was saying." Excerpts from the responses of several students illustrate how reading their draft was linked to *reviewing* and *analyzing* the flow of their message in addition to *evaluating* the content of the message itself. As they wrote:

I just reviewed little parts of my draft. I did this to make sure I was making sense. It helped me again keep to what I thought were the major issues in mandatory drug testing. (Kathy)

Rereading what I wrote really helped me to keep the paper and words flowing. It helped to read what I had just written so that I could connect my ideas in a logical order. Rereading just helped me keep on track as to what I was trying to say. (Sara)

This (reading the draft) helps me realize whether or not the thoughts flow. Sometimes I realize that I have not explained myself thoroughly and restate my ideas. (Dawn)

Similarly, as reported earlier, analysis of students' protocols also indicated that the act of reading one's own essay was largely associated with students' efforts to *plan-organize* (35.5%) and *analyze* ideas (23.4%).

Decisions to Read or Write

Analysis of the debriefing interviews revealed that the tendency across students was to recall and describe those moments when they undertook a shift from reading the articles to writing notes, reading the articles/writing notes to writing the essay, and writing the essay to reading the articles.

Reading articles to writing notes. Students' decision to shift from reading the resource articles to writing notes was most frequently associated with a kind of fine tuning or reshuffling of thoughts and ideas. This is reflected in their need to organize and plan for future writing, as well as analyze existing ideas and information. As the comments of several students indicate:

I needed to narrow my thoughts, categorizing them into specific points. (Pam)

I paused to think about how I could reorganize the information (in the articles) . . . to organize my thoughts into a manner which I can use in writing. (Dawn)

I wanted to objectively look at both sides so I listed the arguments of the pros and cons for MDT. I hoped this would help me clarify my stance. (Kathy)

The comments of a fourth student reveal how her decision to begin writing notes was both a combination of her need to analyze and assess her own understanding of the issues as well as to generate her own opinion. As she explained:

I made the decision to write (notes) because I needed to organize the information I had just read. By writing the information down, I could read it and begin to form some of my own opinions concerning the topic. I could also see what aspects of the topic I was still unclear about and needed to reread in the articles. (Wanda)

Reading articles/writing notes to writing essay. Students' decision to shift from reading articles/writing notes to writing the essay is most frequently associated with the need to "get something down" on paper, or to actually begin the task of formulating their arguments and opinions. The comments of three students reflect this need to make their thoughts, ideas, or arguments materialize or become more "visible." As they wrote:

I began writing the draft because I needed to start my argument or trying to convince people of my ideas. I was beginning to form some ideas of how I would convince people and I wanted to get them down on paper before I lost them totally. (Sara)

I started writing because I had to get something down. The best way for me to begin a paper is to just write. It may not be the best writing or accurate but it has to start. I can always go back to it later. (Nina)

I felt I had sufficient organization to begin writing a draft. I had a good basic outline of general ideas. I rarely add supporting details in the outline. These can be added, either from my thoughts or spontaneously, later (during writing). (Dawn)

Writing the essay to reading articles. Students were also aware of their decisions to return and reread their resource articles once they had begun writing their essay. This shift often occurs as a result of students' need to "find support" for their claims, and to verify the correctness of specific information. The comments of two students reflect this need to return to the resource texts in order to acquire specific information as well as to analyze and evaluate the correctness of existing information:

I stopped writing the (essay) and returned to reading in order to look for specific information from the articles. (Dawn)

I usually stopped writing (the essay) to look back over the articles and make sure that when I wrote the claims of each side that what I was writing was actually what they (authors) were saying. (Kathy)

I also went back to reread and clear up some questions which came to mind as I was writing. (Wanda)

However, this shift also occurred as a result of one student's need to analyze or get a different perspective on their thinking. As this student explained:

I needed to stop writing to go back and read so I could get a new perspective on my ideas. (Sara)

The Profiles of Two Learners

Two selected students (Kathy and Lisa) were chosen for profile analysis because together they represented the range of reasoning operations and the specific reading and writing behaviors that emerged from the group. Their think-aloud protocols served as the source of information concerning changes in their reasoning over time. Analysis of the debriefing interviews provided insight into students' prior knowledge, how their knowledge changed, their decisions to shift between forms of reading or writing, and how they were able to use different forms of reading and writing to accomplish their goals.

Kathy

Prior knowledge and knowledge change. Kathy's responses to specific debriefing questions about her previous knowledge and interest in the topic reveal that she began reading the resource articles having developed no definite opinions on the issue. While she reports having watched "a couple of TV clips on the topic," she had not formally taken the time to develop her views. As she explained:

> *I really didn't feel strongly either way because I hadn't taken the time to evaluate and come to a clear stance on the issue.*

In describing how her knowledge and opinions evolved, Kathy's comments reflect what is perhaps the most thoughtful consideration of the problem of drug testing thus far. As she explained how the free thinking in which she engaged subsequent to reading the resource articles and writing notes helped her to recognize the inconsistencies of a strictly "pro or con" approach to the problem:

> *Initially after reading the articles I thought I was against mandatory drug testing. But while I was brainstorming (free thinking) I realized that that was inconsistent with what I really valued. The major point was when I realized both the employer's freedoms and the employee's freedoms need to be considered and protected.*

Kathy's comments also provide initial evidence of the collaborative nature of the reading and writing exchanges in which she engaged. For instance, her decision to shift from reading the articles and begin a kind of brainstorming provided her with a different perspective or a different way of thinking about the topic which in turn helped her to discover the contradictions in the views she was beginning to develop.

Decisions to read or write. Additional examination of Kathy's decisions to shift from one form of reading or writing to another, in conjunction with the purposes that these activities served, provide further evidence of the purposeful nature of her reading and writing as well as the collaborative exchanges and perspective taking that these shifts permitted. For instance, Kathy explains that reading the resource articles provided her with essential information regarding the arguments both for and against drug testing. As she explained how reading these articles helped:

> *First of all the articles brought to my attention the dispute or problem between mandatory drug testing and nonmandatory drug testing. It was good to see both sides of the issue and know the basis of the arguments for both sides.*

Subsequent to reading the articles, Kathy's comments indicate that she needed to take a more objective look at the arguments on both sides of the issue. In order to examine the topic from this perspective she stopped reading and began writing notes:

> *I wanted to objectively look at both sides so I listed the arguments of the pros and cons for mandatory drug testing. I hoped this would help me clarify my stance. Listing both sides helps me to do that.*

However, her decision to shift from reading the articles and writing notes to free thinking, reveals her need to acquire yet another perspective on the issues that neither reading the articles or writing notes could provide. As she explains her decision to begin brainstorming:

By brainstorming rather than reading (and note writing), I was able to see inconsistencies and contradictions in my own thinking. It helped me clarify what issues I wanted to concentrate on and helped me figure out what solution I would need to come up with which would be consistent with what I believed to be right.

In this instance, Kathy's comments continue to provide a sense of the importance of the internal collaborative exchanges between these three activities: reading the articles providing the initial exposure to the basic arguments; writing notes offering a more objective view of the specific arguments; and free thinking allowing for a more careful examination of the inconsistencies in her own thinking. In addition, Kathy explains that writing the essay actually enabled her to "think through" and finally come to terms with her own beliefs and thoughts about drug testing:

This (writing the essay) helped me think through what I actually thought on the issue. It helped me make decisions and take a stand on the issue. It made me think out a logical reason with support for my stance.

Finally, Kathy's decision to return to reading the resource articles while still in the process of writing her essay represents another instance of the sort of collaborative exchanges made possible through different reading and writing engagements; reading, in this instance, serving as a means to verify the accuracy of specific information.

I usually stopped writing to look back over the articles and make sure that when I wrote the claims of each side that what I was writing was actually what they were saying.

Conceptual insights. Consistent with her ability to direct her reading and writing engagements as it was relevant to her needs, Kathy was also able to identify and describe how specific reading and writing activities helped to bring about important insights or breakthroughs into the topic. She described how one such breakthrough occurred as she engaged in free thinking subsequent to reading the articles and writing notes:

Initially after reading the articles I thought I was against mandatory drug testing. But while I was brainstorming (free thinking), I realized that that was inconsistent with what I really valued. The major point was when I realized both the employer's and the employee's freedoms need to be considered and protected. That is the major point at which my views were changed and solidified.

As illustrated in Table 8, excerpts selected from throughout the think-aloud protocol of Kathy provide a sense of the evolution of this breakthrough and the development of her ideas. Specifically, these excerpts chronicle the recursive nature of Kathy's reading and writing engagements in her struggle to articulate her own solution to the problem of drug testing, one which she explains will "protect the rights and freedoms of both employers and employees." In addition, these excerpts provide further evidence of different perspectives or ways of thinking which Kathy makes possible through her collaborative use of reading and writing.

[Insert Table 8 about here.]

For example, the table illustrates that as Kathy began reading the resource articles she was confronted with arguments both for and against drug testing. As these early excerpts from her protocol indicate, her position seems to change quickly as a function of the opinions she is reading; agreeing that drug testing is an invasion of privacy while also agreeing with employer's right to provide a safe workplace through testing.

While writing notes, Kathy makes her first attempt at clarifying her view, taking the position that drug testing is justified if an employer has reason to believe that an employee is using drugs. However, as she returns to reading the articles in search of specific information to support her tentative view, she questions the fairness of testing even as a precondition for employment.

As she progresses, Kathy's comments during a period of free thinking or brainstorming reveal a breakthrough of sorts, as she reconceptualizes the issue of testing as a problem in which the rights of both employees and employers seem to be in conflict. At this point, having read the articles, written notes, revisited the articles, and engaged in free thinking, writing the essay allowed Kathy to further define and articulate her view, which, as she commented, "keeps in mind the freedom of both employers and employees."

Yet, as the next excerpt of her protocol reveals, Kathy's decision to momentarily stop writing in order to engage in reading her notes provided her with a perspective from which to keep sight of the direction and focus of her essay. Examination of Kathy's debriefing response concerning the role that reading her notes served, helps to further explain the thinking underlying her shift from writing the essay to reading notes:

> *Reviewing my notes helped me remember my original thoughts and ideas. It stimulated other thoughts and helped me stick to my focus and not get off track.*

As revealed in the final paragraph of her essay, Kathy's combined engagements in reading and writing led her to advocate an approach to drug testing which acknowledges the rights and freedoms of both employees and employers. This approach forms the cornerstone of her "Equal Rights Policy," which as she explains "denounces MDT on a national level because that would take away both the employer's and the employee's rights of freedom and privacy."

Reasoning operations and cognitive change. As excerpts from the protocol of Kathy reveal how her knowledge and understanding of the issues progressed as she read and wrote, analysis of the changes in her patterns of reasoning operations across the task provide further evidence of this progress. Examination of Table 9 indicates that Kathy was inclined to engage in proportionally less *questioning* (24.7% to 14.8%), *citing evidence* (3.2% to 1.9%), *paraphrasing* (23.7% to 1.9%), and *using schema* (29.0% to 35.2%), while engaging in greater proportions of *metacommenting* (6.5% to 18.5%), *restating* (0.0% to 3.7%), *validating* (2.2% to 5.6%), and *hypothesizing* (10.8% to 18.5%) as her work progressed. In sum, as her work progressed, Kathy engaged in increasingly greater proportions of *metacommenting*, *restating*, *hypothesizing*, and *validating* with the proportion of *questioning*, *using schema*, *citing evidence*, and *paraphrasing* declining steadily.

[Insert Table 9 about here.]

Results of the analysis of sequential dependency as presented in Figure 4, provide further information concerning the probabilities of specific patterns of reasoning occurring subsequent to *questioning*, *hypothesizing*, *validating*, *paraphrasing*, and *restating* at various points across the task. As the figure indicates, Kathy's thinking was most frequently characterized by significant patterns of reasoning subsequent to *hypothesizing*, *validating*, *paraphrasing* and *restating*. However, examination of Kathy's reasoning over time indicates that these sequences were more or less likely to occur subsequent to different reasoning operations at different times over the course of the task. For instance, during the first stage of her work, significant ($p < .05$) sequences of reasoning occurred subsequent to *questioning* and *hypothesizing*, with a question being followed by a *question*, and a *hypothesis* being followed by a sequence of three consecutive *hypotheses*. This is in sharp contrast to the fourth and final stage of Kathy's work during which time her thinking was characterized by the occurrence of a significant pattern of *validating* and *hypothesizing* occurring subsequent to *validating*.

While these patterns of reasoning represent Kathy's thinking at opposite ends of the task, an examination of her reasoning patterns during the second and third periods of time provide a better sense of continuity and the evolution of these changes. For instance, across the second and third stages of Kathy's work, significant shifts in the patterns of her reasoning begin to emerge. In particular, while reasoning patterns continue to occur after *questioning* and *hypothesizing* in the second stage of work, significant patterns appear in conjunction with *validating*, *paraphrasing*, and *restating* for the very first time. In general, these patterns indicate that at this time Kathy's reasoning is characterized by sequences of *validating*, *citing evidence*, and *paraphrasing*. In the third time period, Kathy's patterns of *restating* and *paraphrasing* are less extensive, while *hypothesizing* leads to a more extensive sequence of *hypothesizing* in conjunction with *validating* and *citing evidence*.

[Insert Figure 4 about here.]

In sum, these results corroborate and further define previous findings from the analysis of Kathy's protocol which revealed her tendency to engage in more *validating*, *hypothesizing*, as her work progressed. In sum these results also support findings from both the analysis of Kathy's protocol and her debriefing interview which revealed how her understanding of the topic and her thinking changed as she directed her own reading and writing engagements enroute to learning.

Lisa

Prior knowledge and knowledge change. Lisa's responses to specific debriefing questions about her previous knowledge and interest in the topic reveal that she began reading the resource articles having already developed some strong feelings and opinions against drug testing resulting from her own personal experience. As she explained:

> *I hadn't read much about it but a friend of mine on a diving team had to go through drug testing and it really didn't seem fair. We talked about it a lot and I never did agree with it. I was really offended that he had to be subjected to it.*

However, in spite of her previous experiences, as Lisa describes how her knowledge and views on the issue of drug testing developed, her comments reflect a complete change of position. Lisa attributes this reversal of opinion to her acceptance of three basic arguments presented in the resource articles. As she explained how her thinking changed:

> *At first I was against drug testing, but as the authors explained that the only reason against drug testing was that it is an invasion of your privacy and that the reasons for it were 1) to save lives, 2) to reduce costs for employers, and 3) to help people get off drugs, it didn't seem that important that a little of my privacy was invaded. Now I'm for it.*

Surprisingly, Lisa's comments also reflect a reluctance to defend her previous views, choosing instead to assume a more passive disposition toward her own learning; content on being informed by the authors as opposed to using her reading and writing to conduct a more critical examination of her ideas in relation to the ideas of the articles. Indeed, Lisa saw the issue of drug testing as an uncomplicated one, and as her comments illustrate, an individual was either on one side or the other. As she remarked, "At first I was against it . . . Now I'm for it."

Decisions to read or write. Examination of Lisa's decisions to shift from one form of reading or writing to another, provide further evidence of her passive disposition and underlying lack of intentionality with respect to the reading, writing, and learning in which she engaged. For instance, Lisa explained that reading the resource articles helped her to understand both sides of the issue while causing her to raise questions about drug testing. She could then seek answers to these questions as she continued to read. However, the thinking underlying her decision to shift from reading the articles to writing notes reflects a less purposeful approach to making progress toward her goal; an approach governed by chance rather than by intentions. As she drifted among engagements, first writing and then reading the articles, it is clear that the collaborative reading and writing exchanges and perspective taking in which she engaged were built upon chance. As she wrote:

> *After I finished reading the articles, I was going to start writing just because that seemed to be the next obvious step. I tried but I couldn't. I had no idea where to start so I browsed through the beginnings and endings of the articles hoping that something would grab me and help me start but nothing did. So I thought I would take some basic notes, e.g., reasons for and against drug testing. I thought that these would help me sort out my ideas and give me a place to start.*

While Lisa seems to be aware of the purposes for which writing notes might be used ("sort out my ideas"), she seems uncertain with respect to when and why a particular engagement shift would be appropriate. The problems created by Lisa's decision to begin writing notes without purpose or direction is compounded further when she returns to her notes for support later in the task:

I looked at the notes I wrote, but they weren't very helpful. I looked at them when I got stuck but they weren't detailed enough to help me.

As a result, when Lisa needed help in the process of writing her essay, she had no other choice but to continue to reread the resource articles, again taking a passive stance toward her own learning--waiting for something to "inspire me." As she explained her decision to shift from writing her essay to reading the resource articles:

When I was writing and got stuck, I usually reread what I had just written and thought about it but if nothing came to me I went back to the articles hoping to get some ideas. Most of the times I was just looking for something to sound appealing and to inspire me but a few times I kind of remembered something and wanted to see exactly what it was that the text said.

It is clear that Lisa returns to read the resource articles with a purpose--she is "stuck." However, her expectations appear to place the responsibility of progress on the text rather than on herself as she waits to be inspired.

Conceptual insights. The problems which result from Lisa's inability to take control of her own cognitive destiny as a reader and a writer are further reflected in her debriefing comments concerning the evolution of her thinking and the development of conceptual breakthroughs. As her remarks illustrate:

I never felt a major breakthrough. I never knew exactly where it (the essay) was going. I wrote this essay one sentence at a time. I never knew where this was headed. Sometimes things seem to click but in this essay it never did. I just kept trudging through hoping something would come to me.

As Table 10 illustrates, excerpts selected from throughout the think-aloud protocol of Lisa provide a sense of her struggle to make progress and to complete her essay. Much like Lisa, these excerpts portray the development of her thinking as she wrestled with how to reconcile the problems of testing with respect to employee privacy and employee safety.

However, while Lisa tended to view the issue of drug testing as rather straightforward examination of her protocol indicates that she seemed unable to take a stance. Instead, she appears to be at the mercy of the articles, constantly returning to them in the hope of being inspired, and altering her own opinions under the direction of the particular author that she happened to be reading. As a result, when she finally does take a stance, her position is not well developed or articulated persuasively.

[Insert Table 10 about here.]

For example, as reflected in the protocol excerpt which precedes the excerpt of her actual essay, Lisa's confusion stems not only from the conflict between her own views, but with her need to continually stay in step with the opinions presented in the articles. As she commented:

So this sentence about testing being ok sometimes, messes up my argument. But then that's what they said in the article.

The last paragraph from Lisa's essay indicates that she was able to come to her own conclusion on the issue of drug testing in the workplace, although she seems unable to articulate her major arguments in a logical and persuasive manner. For example, while she states that protection of lives justifies an invasion of privacy, she also seems to suggest that losing one's job is an acceptable option, should you not want your privacy invaded. Furthermore, while she did arrive at a conclusion, the two and one-half hours she needed in order to complete her essay are reflection of the difficulty she had in making progress.

In sum, this table reflects previous findings which indicated that 50.1% of Lisa's thought units occurred in conjunction with reading the resources articles. Indeed, as reading the articles dominated her activities, few collaborative exchanges among other forms of reading and writing occurred.

Patterns of reasoning operations and cognitive change. As excerpts from the protocol illustrate how Lisa's knowledge and understanding of the issues progressed as she read and wrote, analysis of the changes in her patterns of reasoning operations across the task provide further evidence of this progress.

Examination of Table 11 indicates that Lisa was inclined to engage in proportionally less *questioning* (29.3% to 0.0%), *hypothesizing* (12.1% to 2.1%), *citing evidence* (11.3% to 2.1%), and *validating* (1.5% to 0.0%) while engaging in greater proportions of *metacommenting* (6.0% to 23.4%), *using schema* (24.1% to 42.6%), and *restating* (1.5% to 19.1%) over time. The percentage of paraphrasing tended to vary considerably, both rising and falling throughout the task. In sum, Lisa engaged in increasingly greater proportions of *restating* content, *using schema*, and *metacommenting*, with the proportion of *questioning*, *hypothesizing*, *citing evidence*, and *validating* declining steadily as the task progressed.

[Insert Table 11 about here.]

Results of the analysis of sequential dependency as presented in Figure 6, provide further information concerning the probabilities of specific patterns of reasoning occurring subsequent to *questioning*, *hypothesizing*, *validating*, *paraphrasing*, and *restating* at specific points across the task.

Overall, examination of Figure 6 indicates that Lisa's thinking was most frequently characterized by significant patterns of reasoning subsequent to *paraphrasing* and *restating content*, with the most extensive patterns of reasoning occurring subsequent to *paraphrasing* in the final stage of her work. As Lisa engaged in reading and writing, the probability of a *paraphrase* being followed by *using schema*, *citing evidence*, or more *paraphrasing* was significant at the .05 level across all four stages of the task. Results also indicate that the probability of a restatement being followed by *paraphrasing*, *using schema*, and more *restating* was also significant ($p < .05$) across all four stages.

[Insert Figure 6 about here.]

In addition, while *questioning* and *hypothesizing* were likely to be followed by a single question and a single hypothesis respectively in the first stage of her work, these operations led to a different sequence of reasoning in the third period of the task. For instance, at this point in her work, the probability of a *question* being followed by *citing evidence* which then led to *validating* was significant at the .05 level. Likewise, at this time, a *hypothesis* frequently led to a *validation* which led to a *metacomment*. The only significant pattern of reasoning found to follow validating occurred during the second period of time.

In sum, these results reflect and further define previous findings from the analysis of Lisa's protocol which revealed her tendency to engage in more *paraphrasing* and *restating* as her work progressed. In addition, these results also corroborate findings from the debriefing interview in conjunction with the analysis of protocol excerpts which illustrated Lisa's willingness to be directed by the ideas in the resource texts; continually engaging her in the process of *restating* and *paraphrasing* the opinions and views of the authors.

LIMITATIONS OF THE STUDY

On the positive side, the present study represents a unique attempt to study the effects of different forms of reading and writing upon students' thinking and learning. Whereas past studies have examined the effects of a rather static and prescribed array of reading and writing engagements upon students' thinking and learning from texts, this research pursued the question of how students' ability to direct their own reading and writing activities was reflected in their writing and learning. This study was also unique in its attempt to chronicle the way in which students' thinking changed across a given task as a result of their combined reading and writing engagements, as well as to examine students' decisions to undertake various shifts among specific activities enroute to their goal. Finally, whereas previous studies have sought to examine the types of reasoning associated with specific reading or writing modes, this research explored reasoning as a function of both engagements and the purposes for which those engagements were undertaken.

On the negative side, there are several limitations to this type of study. First, while students were permitted to direct their own reading and writing activities, both the topic of study and the final product (a persuasive essay) were determined by the researcher. Indeed, the nature of the topic and product may have in a sense defined the nature of students' engagements. Second, while the study presented the results of an indepth analysis of the thinking and learning that resulted from students' self-directed reading and writing, more case studies need to be conducted with a wider range of students studying a range of content materials in order to assess the generalizability of the findings. Third, research findings based upon debriefing comments and think-aloud protocols have been questioned due to the suspect nature of self-reports (Afflerbach & Johnson, 1984). Specifically, whether or not such think-aloud procedures accurately reflect one's thinking or in fact, change the course of one's thinking remains problematic. On the other hand, these type of data are vital if we are to go beyond what is on the page to what is in the mind of readers and writers (Flower & Hayes, 1980; Langer, 1986; Norris, in press).

DISCUSSION AND CONCLUSIONS

The work of Katz (1982), Giroux (1988), Guthrie (1986), McGinley & Tierney (1988), Murray (1982), O'Flahavan and Tierney (in press), Tierney, Soter, O'Flahavan, and McGinley (in press), and Walters, et al. (1987) provided the theoretical underpinnings for examining the relationship between students' ability to purposefully direct their own reading and writing engagements and the nature of the thinking and learning which resulted from these engagements. In this context of learner-initiative and self-regulation, this investigation also explored the different purposes for which specific forms of reading and writing were used and how these purposes, as well as the nature of the thinking in which students engaged, changed over the course of a given learning task.

Analysis of the think-aloud protocols and debriefing interviews demonstrated that the thinking in which students engaged, and how it changed in literacy tasks such as this, is a complex phenomenon mediated by both reading and writing engagements and the specific pu.poses for which these engagements were undertaken. Across students, various forms of reading and writing proved to be very versatile activities, engaging students in different types of reasoning as well as providing them with the means to fulfill a number of different purposes.

Examination of the *relational structure* which exists between students' purpose, their reading and writing engagements, and their reasoning operations provided insight into several areas concerning the reading and writing in which they engaged. Analysis of the protocols revealed that students' purposes throughout the task had a direct influence on the specific *type* and *number* of reading and writing activities that they used in order to accomplish those purposes. For instance, as students sought to *update* and *acquire* information, a single activity such as reading the resource text served their purpose. However, in order to *plan* and *organize* their ideas, a number of activities such as writing the essay, reading the resource texts, and writing their notes were employed.

In exploring the relationship between engagements and reasoning, the protocols revealed that students were involved in different patterns of reasoning as they moved from one form of reading or writing to another. These results are particularly important in that they extend the findings of a group of studies which have sought to examine reasoning as a function of specific reading or writing engagements independent of the multiple purposes that a single reading or writing activity is capable of serving when students are permitted to direct their own reading and writing engagements in pursuit of some other learning (Durst, 1987; Langer, 1986; Langer & Applebee, 1987; Marshall, 1987; Newell, 1984). However, the present study suggests that there is no one-to-one correspondence between reading and writing engagements and the reasoning operations which characterize students' thinking. Rather, it suggests that the thinking in which students engage during different kinds of reading or writing, and how it changes, is a complex phenomenon mediated by both engagements and the specific purposes for which they were undertaken. Results also suggest that students' purposes tended to vary considerably over the course of their combined reading and writing activities.

Additionally, while this class of very influential studies of writing and learning provides evidence to support the use of analytical essay writing, extended essay writing, and personal writing in fostering understanding in social science and literature, the findings of this study suggest that we need to continue to explore the question of whether or not such results are due to the influence of writing alone or to a

variety of other recursive reading and writing engagements that students *may* have undertaken in the service of writing their essays.

In addressing this issue, a recent study by Tierney et al. (in press) of students who were *directed* to engage in more complex combinations of *reading an article* in combination with *writing an essay*, in conjunction with *answering questions* about a topic, revealed that these *combinations* involved students in a more balanced array of reasoning operations and induced them to adopt a more critical disposition toward what they were studying. Similarly, the present research suggests that changes in students' thinking and learning over time occurred as a result of their ability to orchestrate a number of different reading and writing activities *in conjunction with* writing their essay. Indeed, results from both studies suggest that the extent to which students are able to think about and explore a topic of study must be attributed to the *combined* reading and writing activities in which they engaged enroute to writing their essay rather than just the essay itself.

In addition, the extent to which students enlisted various *combinations* of reading and writing varied considerably at specific points from the beginning to the end of the task. In general, the tendency of students over time was to engage in increasingly more diverse combinations of specific types of reading and writing as opposed to relying upon a *single* activity in order to make progress toward their goal. In particular, while reading the resource texts tended to be the dominate activity in early stages of the task, students' engagements in the middle to later portions of the task, when writing the essay dominated, were characterized by relatively more diverse combinations of a number of reading and writing activities. In these time periods, students were engaged in writing notes, reading their notes, reading the resource texts, reading their own essay, *and* writing the draft of their essay.

The ability to combine different forms of reading and writing enroute to conducting a topical inquiry is reflected in varying degrees in the reading, writing, and learning of Lisa and Kathy. In general, Kathy, having begun her work with no formal opinions on the topic, used her reading and writing in order to first *discover* and then clarify what she actually believed. Lisa, on the other hand, was "carried along" by her reading and writing, readily changing her original beliefs in favor of the views expressed in the articles before finally arriving at her own position.

As Kathy and Lisa represent the range of reading and writing behaviors evidenced by the students in this study, their collective engagements can be conceptualized as the *means* by which they gradually engineered a shift *away* from the resource articles and the opinions of others enroute *to* the development of their *own* texts (notes, draft) and their own ideas on drug testing. This movement is most apparent in the activities of Kathy as she sought to *discover* and *reaffirm* her beliefs. In general, reading the resource articles served as the means to initially confront and react to the important arguments and issues. From this point, writing notes represented a kind of "first step" away from the articles toward the development of their own ideas as students sought to "see" or "position" their thoughts in relation to the information presented in the articles. In the case of Kathy, the act of brainstorming served as yet another means to move away from the articles enroute to forming her opinion, helping her to see the inconsistencies in their own thinking. Finally, the act of writing the essay served as a mode through which students formalized their views, allowing ideas to come to fruition as they created a text of their own.

In contrast, Lisa's inability to appropriately use activities such as notetaking, brainstorming, writing, etc., in order to "break free" of the articles represented the core of her difficulties, as she struggled to make progress and articulate her own opinions throughout her work. Indeed, Kennedy's (1985) examination of the composing processes of six college students writing from sources revealed similar results for less able readers and writers. As she reports, such students "drew heavily on their sources, rereading them, extracting direct quotations, and inserting them into the piece" without ever gaining ownership of the ideas (p. 449). Flower (1981) also referred to this approach to texts in describing the reluctance or inability of some students to effectively use the ideas of others in the development of their own texts. According to Flower, such students use a kind of "survey strategy," borrowing phrases and piecing together the writing and ideas of another (p. 154). In a similar vein, results of a recent study of how the writing context shapes college students' strategies for writing from sources, Nelson and Hayes (1988) found that college students varied considerably with respect to the way in which they used reading and writing in order to formulate a research paper. For example, while some students used a variety of

reading and writing activities in order to transform source material enroute to producing original ideas and conclusions, others were content with more "low-investment" reading and writing strategies which enabled them to merely reproduce information found in a variety of sources.

In addition, Kathy was able to bring about a conceptual breakthrough or insight into the topic over the course of their combined reading and writing engagements. Similarly, VanDeWeghe (1987) also documented the "heuristic moments" or "conceptual leaps" experienced by writers in the process of composing texts of a more personal nature. However, as evidenced by this study, such breakthroughs need not occur only during writing. For example, Kathy's major insight occurred as a result of her *brainstorming* or free thinking subsequent to reading the articles and taking notes. Lisa, on the other hand, reported never really achieving any major conceptual insights.

Overall, this study suggests that different forms of reading and writing are indeed different ways of thinking and knowing. In light of the work of Wittgenstein (1953) and his prominent metaphors for knowledge organization and learning (particularly the metaphor of the "criss-crossed landscape") in conjunction with the more recent work of Spiro et al. (1987) in knowledge acquisition, various forms of reading and writing can be conceptualized as those *cognitive acts* which provide a learner with multiple "traversal routes" or perspectives from which to "criss-cross" and explore a topical landscape. Indeed, the reading and writing in which Kathy and Lisa engaged represent in varying degrees their efforts to "criss-cross" the topic of study enabling them to highlight the complexities of certain issues as well as establish sources of support to be used throughout the task. This use of reading and writing is further reflected in Spiro's comments concerning the importance of "criss-crossing:"

> By criss-crossing the complex topical landscape, the twin goals of highlighting multifacetedness and establishing multiple connections are attained. Also, awareness of the variability and irregularity is heightened, alternative routes of traversal of the topic's complexity are illustrated, multiple routes for later information retrieval are established, and the general skill of working around that particular landscape is developed. (p. 8)

These findings also provide strong evidence of the "internal collaboration" (Pearson & Tierney, 1984; Tierney, Leys, & Rogers, 1984) or vicarious dialogue that often emerges from the self-directed exchanges that a single learner may orchestrate among different forms of reading and writing enroute to acquiring knowledge on a topic; each particular activity providing an individual learner with its own unique perspective from which to examine the topic of study as well as to examine their own thinking. Indeed the emerging picture is one of a single learner, creating through his or her recursive engagements, a kind of *vicarious community* of readers and writers exchanging perspectives with one another as they move back and forth between writing notes, reading the text, writing the draft, reading the draft, and reading their notes.

This particular view of literacy and learning, which places a single learner at the center of a vicarious community of collaborative readers and writers, exchanging topical perspectives and providing one with different ways of knowing and "traversing" a topical landscape leaves us with some provocative questions to answer. On one level, it asks that we continue to explore the nature of the relationship between literacy, student-initiative, and the ability to conduct a thorough inquiry of a topic of study. And, it asks that we explore, in more detail, the nature of such communities, how they evolve, as well as how they vary across students of different abilities and across a variety of rhetorical tasks and topics of study. Additionally, it invites us to examine the relationship between the internal communities which learners construct and the more obvious external communities of teachers and peers--how learners use both communities to accomplish their goals. On another level, it asks that we pursue a more precise exploration of the nature of students' conceptual insights into topics of study and the kinds of collaborative exchanges of readers and writers, both internal and external, that accompanied or led to such insights.

Instructional Implications

Few would argue that one of the more valued cognitive activities associated with formal schooling is the ability to use reading and writing in order to *inform oneself* with respect to various topics or areas of interest. This study suggests that this ability would almost certainly require that individual learners understand the *functions* that different forms of reading and writing are capable of serving in order to avail themselves of the combinatorial power of these acts. However, in actualizing this combinatorial power and in informing oneself, students must also be able to make *timely decisions* about the usefulness of undertaking a specific reading or writing engagement across a task if they are to effectively orchestrate and direct their recursive movements from one form of reading or writing to another. Of what value is the ability to use reading and writing in order to learn if students are unable to *customize* both the specific *types* of reading and writing they elect to undertake for particular tasks as well s the *manner* in which they chose to combine these engagements in order to accomplish their particular goals? How can we foster students' ability to use their literacy skills in conducting a critical inquiry of a content domain if they are always supplied with both the *types* as well as the specific instructional *sequence* of engagements they should undertake?

If we are to develop students' ability to explore topics and issues of importance, we cannot rely on models of instruction which do not equip them with the ability to direct their own reading and writing engagements. Indeed, if we wish for students to take control of their own learning and actively *inform* themselves through reading and writing, we must recognize the importance of learner-initiative in fostering the critical inquiry of topics. As this study indicates, the true combinatorial power of reading and writing can only be realized when a learner is able to orchestrate their own engagements as it is relevant to their particular needs. This research also suggests that students need not only to know *how* to write notes for example, but *when* and *where*, in the course of a task, note writing is most appropriate.

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Table 1

Specific Reading-Writing Engagements

Percent of Thought Units

Engagements	(n)	Pam	Sara	Kathy	Lisa	Dawn	Nina	Wanda	Average %
Read Draft	417	13.7	13.1	7.1	22.6	23.3	8.8	19.2	15.0
Read Texts	1216	31.1	53.1	40.0	50.1	35.3	52.4	39.7	43.8
Read Notes	107	5.3	1.5	4.6	0.0	2.6	7.0	5.2	3.9
Read Assign	14	0.2	0.4	0.7	0.2	0.8	0.6	0.3	0.5
Write Draft	794	38.7	25.1	34.6	25.5	32.9	23.1	21.0	28.6
Write Notes	209	11.1	6.6	7.9	1.6	5.0	7.1	1.4	7.5
Think Texts	17	0.0	0.2	3.9	0.0	0.0	0.9	0.0	0.6
Think Notes	3	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.1
TOTAL	2777	100	100	100	100	100	100	100	100

Table 2

Specific Reading-Writing Engagements Over Time

Percent of Thought Units

	Time 1				Time 2				Time 3				Time 4		
Form	**(n)**	**Write**	**Read**	**Think**	**(n)**	**Write**	**Read**	**Think**	**(n)**	**Write**	**Read**	**Think**	**(n)**	**Write**	**Read**	**Think**
Notes	130	12.0	0.5	0.0	157	10.7	9.2	0.4	24	0.2	3.5	0.0	8	0.0	2.7	0.0
Texts	906	0.0	86.6	0.6	184	0.0	23.3	1.4	114	0.0	17.2	0.0	29	0.0	9.7	0.0
Drafts	2	0.1	0.1	0.0	431	40.1	15.5	0.0	518	49.0	29.1	0.0	260	52.3	34.3	0.0
Assign	1	0.0	0.0	0.0	3	0.0	0.4	0.0	7	0.0	1.1	0.0	3	0.0	1.0	0.0
TOTAL	1039			100%	775			100%	633			100%	300			100%

N = 2777

Table 3

Reasoning Operations During Combined Reading-Writing Engagements

Percent of Thought Units

Reasoning Operations	(n)	Pam	Sara	Kathy	Lisa	Dawn	Nina	Wanda	Average %
Questioning	442	23.1	8.7	16.1	14.7	9.9	19.9	16.6	15.9
Hypothesizing	293	12.2	9.8	18.2	7.9	11.1	11.5	3.3	10.6
Meta-Commenting	469	14.9	21.8	13.9	20.2	15.5	17.5	11.7	16.9
Using Schema	685	25.2	33.4	25.4	21.5	24.2	19.5	23.5	24.7
Paraphrasing	299	4.8	9.8	13.2	15.0	11.7	7.5	18.6	10.8
Citing Evidence	139	3.6	4.6	3.9	6.3	6.4	6.0	3.9	5.0
Validating	154	10.5	2.4	7.1	2.4	2.3	7.7	4.9	5.0
Restating	296	5.7	9.4	2.1	12.1	19.0	10.3	17.6	10.7
TOTAL	2777	100	100	100	100	100	100	100	100

Table 4

How Reasoning Operations Change Over Time

Percent of Thought Units

Time	(n)	Questioning	Hypothesizing	Meta-Comment	Using Schema	Paraphrasing	Citing Evidence	Validating	Restating	Total %
Time 1	1039	18.5	10.9	9.0	29.5	18.2	6.0	3.4	4.7	100
Time 2	775	15.7	12.9	20.0	21.9	5.4	6.3	8.1	9.6	100
Time 3	663	15.7	8.9	19.9	19.5	7.7	3.9	7.1	17.4	100
Time 4	300	8.0	7.0	29.7	26.7	5.7	0.7	3.0	19.3	100
TOTAL	2777									

Table 5

Purposes for Combined Reading-Writing Engagements

Percent of Thought Units

Purpose	(n)	Pam	Sara	Kathy	Lisa	Dawn	Nina	Wanda	Average %
Generate	357	14.9	13.3	17.9	11.8	9.6	14.5	6.5	12.9
Formulate	481	19.3	9.8	18.2	15.2	22.2	20.3	16.6	17.3
Analyze	543	22.7	18.1	15.4	21.0	15.5	19.5	23.5	19.6
Revise	74	1.5	2.8	1.1	5.2	4.7	1.5	2.3	2.7
Plan - Organize	454	18.5	26.0	18.6	12.3	12.5	15.4	7.5	16.3
Update - Acquire	344	7.4	10.7	6.8	16.8	9.9	13.9	22.5	12.4
Evaluate	310	12.8	12.4	17.9	9.4	13.1	7.7	6.5	11.2
Review	214	2.9	6.8	4.3	8.1	12.5	7.1	14.7	7.7
TOTAL	2777	100	100	100	100	100	100	100	100

Table 6

How Purpose Changes Over Time

Percent of Thought Units

Time	(n)	Generate	Formulate	Analyze	Review	Plan - Organize	Update - Acquire	Evaluate	Review	Total %
Time 1	1039	23.9	0.7	23.9	0.1	10.2	23.0	17.1	1.0	100
Time 2	775	10.2	23.0	17.6	2.7	24.8	5.7	8.0	8.1	100
Time 3	663	3.9	29.1	18.3	3.5	17.0	7.5	6.8	13.9	100
Time 4	300	1.0	34.3	12.3	9.7	14.3	3.7	8.3	16.3	100
TOTAL	2777									

Table 7

Purposes Served by Specific Reading-Writing Engagements

Percent of Thought Units

Engagement	(n)	Generate	Formulate	Analyze	Revise	Plan - Organize	Update - Acquire	Evaluate	Review	Total %
Read Draft	417	1.0	5.0	23.7	1.0	11.0	1.2	11.5	45.6	100
Read Texts	1216	8.5	3.4	24.3	0.1	10.5	26.2	15.4	1.6	100
Read Notes	107	11.2	17.8	23.4	1.9	35.5	5.7	6.3	0.0	100
Read Assign	14	0.0	0.0	28.6	0.0	35.7	7.1	21.4	7.1	100
Write Draft	794	7.2	49.3	10.3	8.3	18.9	0.6	5.2	0.1	100
Write Notes	209	22.5	3.8	17.7	0.5	40.2	5.7	9.6	0.0	100
Think Texts	17	52.9	0.0	0.0	0.0	17.7	11.8	17.7	0.0	100
Think Notes	3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
TOTAL	2777									

Table 8

Excerpts from the Think-Aloud Protocol of Kathy

Reading the Resource Articles:

> *I'm reading this part that "you don't hang them all to get the guilty." I think that mandatory testing would be an invasion of privacy and that its against the American tradition of innocent until proven guilty.*
>
> *I agree with the person who says employers have a responsibility to keep the workplace safe and that if there's reason to believe someone is using drugs then a search is justified.*
>
> *I agree with him that people such as pilots and train crew and other people who influence safety they should maybe be forced to take drug tests because the have the lives of other people in their hands. They have a responsibility to other people. But it does seem like a contradiction to say that some should take tests and other shouldn't.*

Writing Notes:

> *So I think I can take the view that all employees should not be forced to take drug tests initially, but if there is reason to believe that they are using drugs the I think that the search is justified.*

Reading the Resource Articles:

> *I think I'll use some of these statistics over again and see if I can use any of these. It does say that there's a 27% increase in the nations' corporations screening job applicants and current employees. I guess I don't think its unfair for an employer to state up front that in order to be hired employees need to go through drug testing. But I don't know if that's a contradiction or not.*

Free Thinking:

> *So I guess it would be if you looked at it from an employer's standpoint or a workers standpoint and either way you pick you're gonna restrict the freedom of one of those two groups.*

Writing the Essay:

> *Based on that I definitely have a comprising view because I think that after reading these articles I think that on a nation-wide scale it shouldn't be mandatory that employers test all employees, but it should be left up to the employers to decide if he want to test all his employees and applicants.*
>
> *I think that my view more keeps in mind the freedom of the employers as well as the employees and doesn't go to an extreme point of either one in saying that only the employees have the freedom not to be tested or only the employers have the freedom to test. So both wil have freedom and their rights will be considered and protected.*

Reading Notes:

> *Ok, so after I state the view of people who don't want drug testing then I would state my own view which is somewhat of a compromise.*

The Essay:

Only a policy which fully protects the rights of both employers and employees would be fair to all people and consistent with the foundations of America in protecting the liberties of all people. The policy which is fair to all people is the Equal Rights Policy. This policy denounce MDT on a national level because that would take away both the employer's and the employee's rights to freedom and privacy. The Equal Rights Policy protects the rights of both employers and employees. This policy states that employers have the right to decide if they want to make drug testing mandatory in their company, but they must state clearly to applicants how they will be tested and what action will be taken if the tests come up positive. So employees have the freedom to choose which companies to apply knowing in advance which ones test for drugs and which ones do not. In this policy neither the employer's or the employee's rights are violated.

Table 9

How Reasoning Operations Change Over Time (Kathy)

Percent of Thought Units

Time	(n)	Questioning	Hypothesizing	Meta-Commenting	Using Schema	Paraphrasing	Citing Evidence	Validating	Restating	Total %
Time 1	93	24.7	10.8	6.5	29.0	23.7	3.2	2.2	0.0	100
Time 2	72	11.1	23.6	6.9	26.4	9.7	8.3	12.5	1.4	100
Time 3	61	9.8	23.0	29.5	9.8	11.5	1.6	9.8	4.9	100
Time 4	54	14.8	18.5	18.5	35.2	1.9	1.9	5.6	3.7	100
TOTAL	280									
Average %		16.1	18.2	13.9	25.4	13.2	3.9	7.1	3.1	100

Table 10

Excerpts from the Think-Aloud Protocol of Lisa

Reading the Articles:

> *After I read the first paragraph and it asks Mr. Bensinger why he's in favor of drug testing, it made me think if I was in favor of it and I kind of think I am, just for the basic safety of the public I guess.*

Reading the Articles:

> *It seems like if they (employees) can work even though they do take drugs then that should be ok. But at the same time there's more of a risk and it doesn't seem that its ok that they should risk the safety of the public. I don't know how I feel about that . . . I'm not sure where you draw the line between an invasion of someone's privacy and protection of the public.*

Reading the Articles:

> *Right now I'm just trying to think if I'm in favor of drug testing or if I'm not in favor of it. I'm in favor of it kinda just because I don't think I'd really be offended if someone asked me to provide a sample because I'm really concerned with other people's privacy. But I can see why other people would be upset.*

Reading the Articles:

> *He says that the tests are unreliable and incapable of determining when drugs were used and that they can't determine such things as impairment of performance and impairment of ability or safety which is important because if people aren't at risk then they shouldn't be subjected to unfair testing.*

Writing the Essay:

> *I feel that small invasion of privacy is alright if there's a chance it will in turn protect the lives of others.*

Reading the Articles:

> *I'm reading the part about employers don't have the authority to regulate what their employees do off the job and I'm getting a little confused because I just said that drug testing was ok but before I said that it wasn't ok, ever. And now I want to say employers can't do it (testing). So this sentence about testing being ok sometimes messes up my argument, but then that's what they say in the article.*

The Essay:

> *I feel that since drug testing has caused a decrease in accidents and deaths it is our responsibility to help implement drug testing nationally. I feel people should have the right to refuse testing which could, in turn, affect their employment status but then they are determining what will happen to them rather than putting many people's lives in jeopardy, which is what could happen if drug testing is banned.*

Table 11

How Reasoning Operations Change Over Time (Lisa)

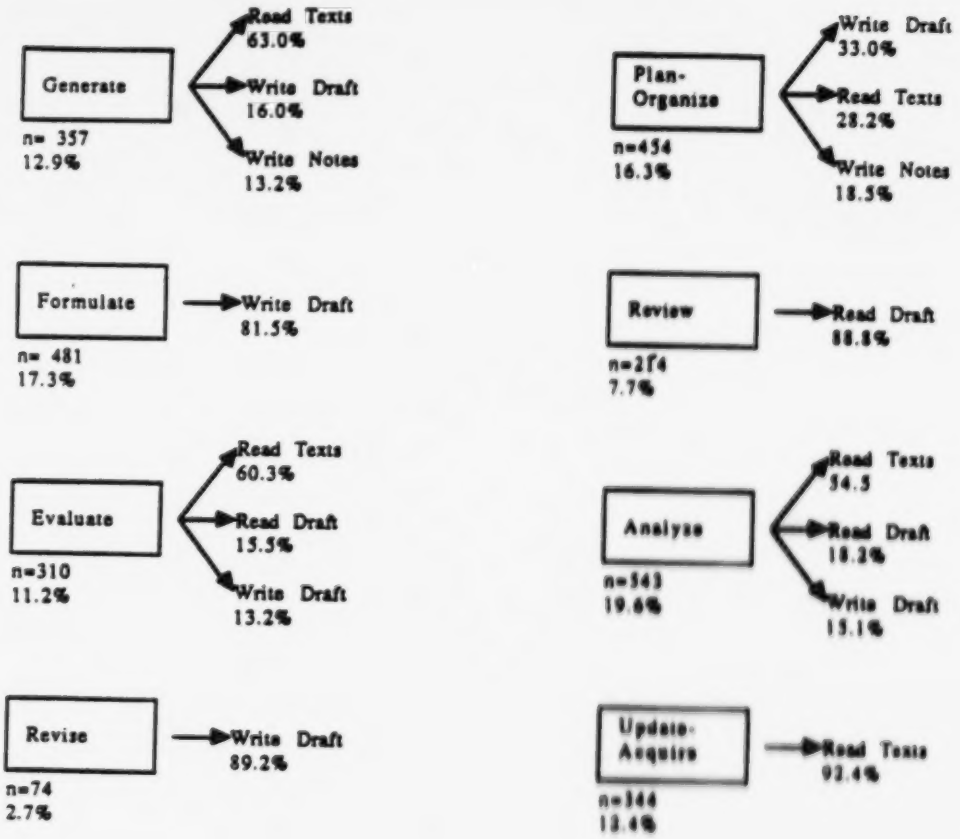
Percent of Thought Units

Time	(n)	Questioning	Hypothesizing	Meta-Commenting	Using Schema	Paraphrasing	Citing Evidence	Validating	Restating	Total %
Time 1	133	29.3	12.1	6.0	24.1	14.3	11.3	1.5	1.5	100
Time 2	95	12.6	5.3	34.7	17.9	6.3	4.2	4.2	14.7	100
Time 3	106	5.7	6.6	22.6	15.1	23.6	3.8	2.8	19.8	100
Time 4	47	0.0	2.1	23.4	42.6	10.6	2.1	0.0	19.1	100
TOTAL	381									
Average %		16.1	18.2	20.2	21.5	15.0	3.9	7.1	12.1	100

Figure 1

How Purpose is Associated with Reading-Writing Engagements

Percent of Thought Units

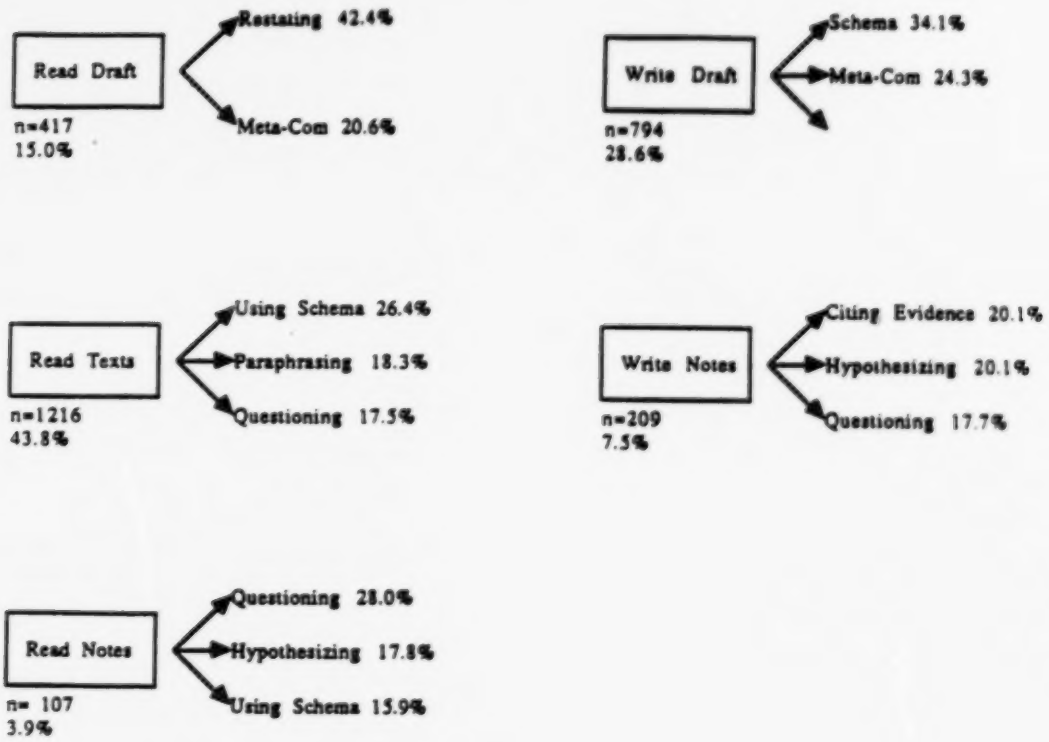


*Combined percentages accounting for at least 50% or more of their respective categories (reading and writing engagemennts) are presented.

Figure 1

How Specific Reading-Writing Engagements are Associated with Reasoning Operations*

Percent of Thought Units

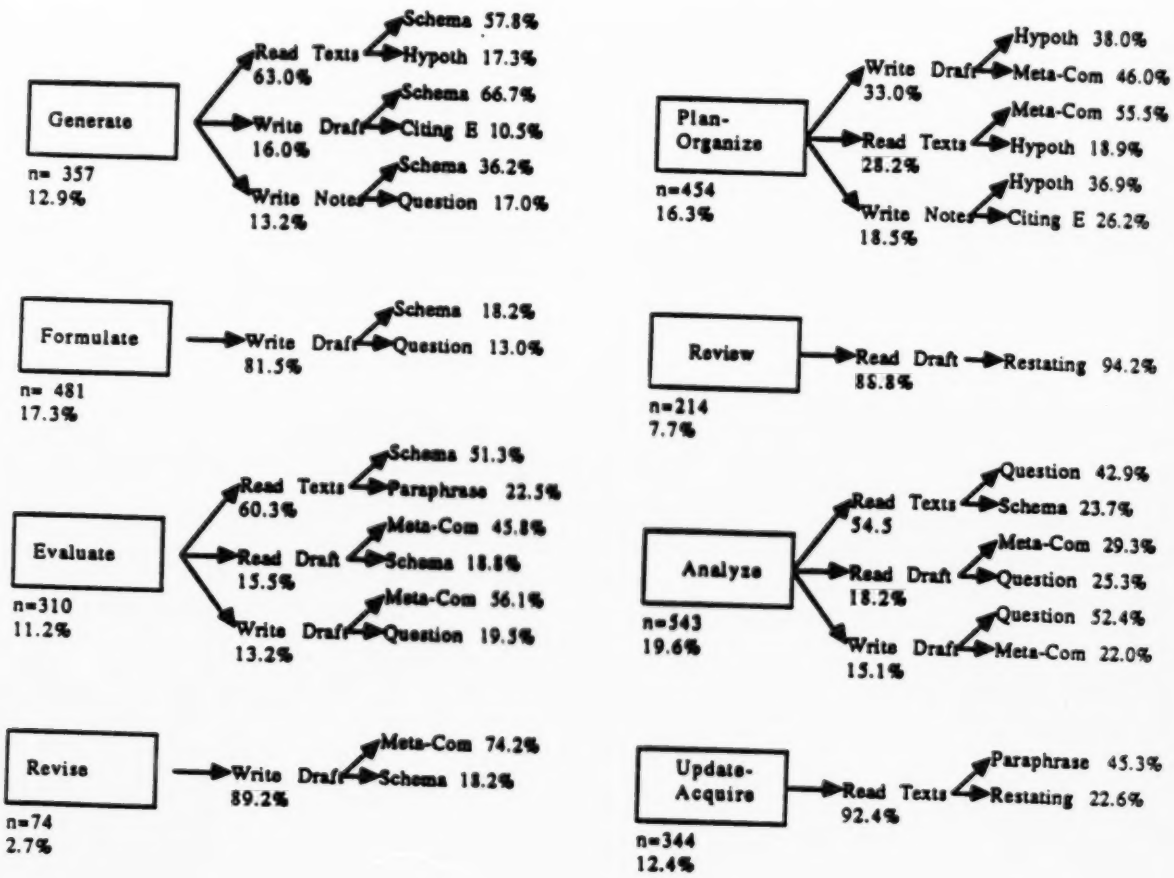


*Combined percentages accounting for at least 50% or more of their respective reasoning operations

Figure 3

How Purpose is Associated with Reading-Writing Engagements and Reasoning Operations

Percent of Thought Units



*Combined percentages accounting for at least 50% or more of their respective categories (engagements or reasoning operations) are presented. For additional information see Tables 9 and 12.

Figure 4
What Happens Subsequent to Specific Reasoning Operations Over Time (Kathy)
Percent of Thought Units

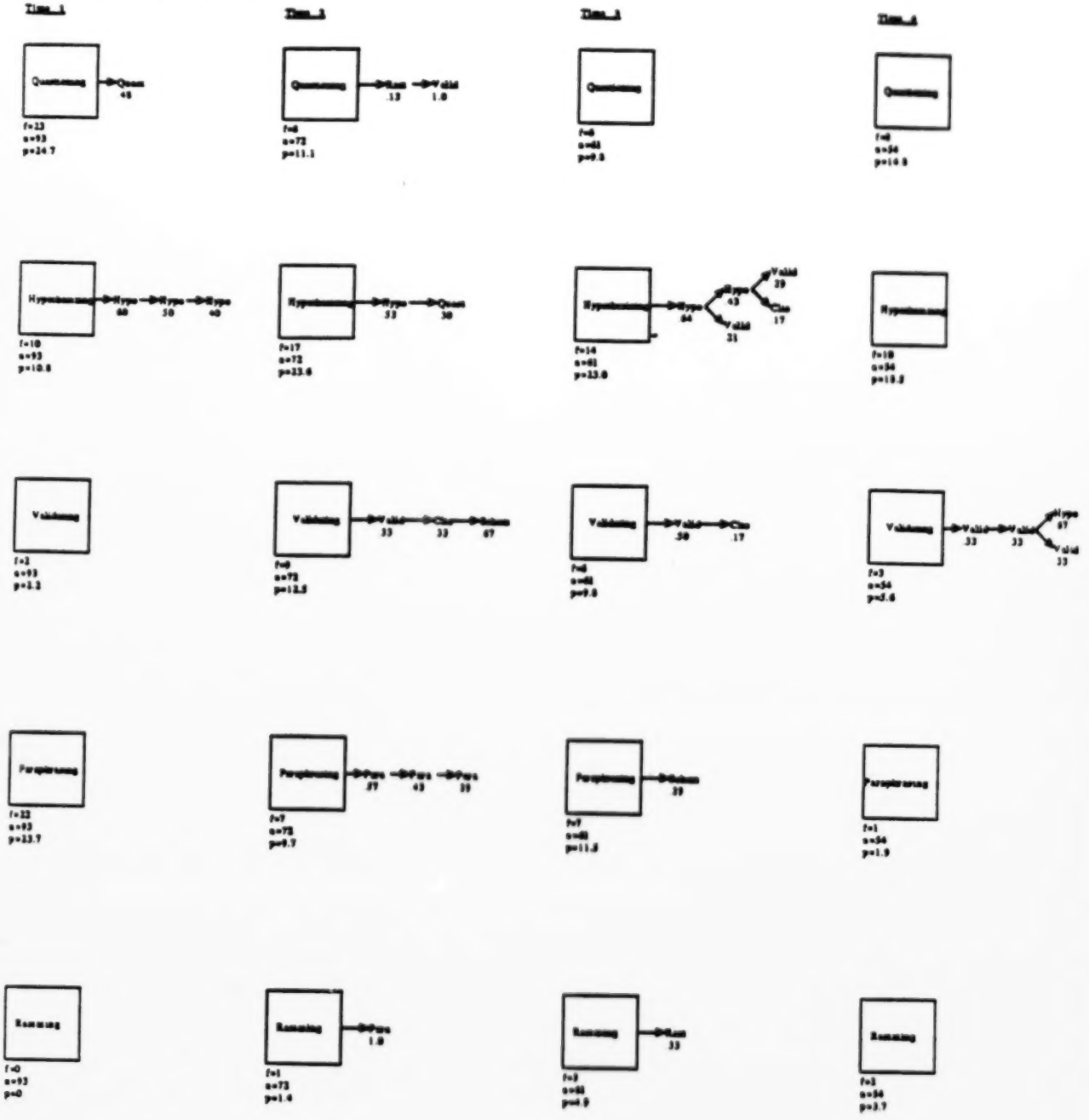
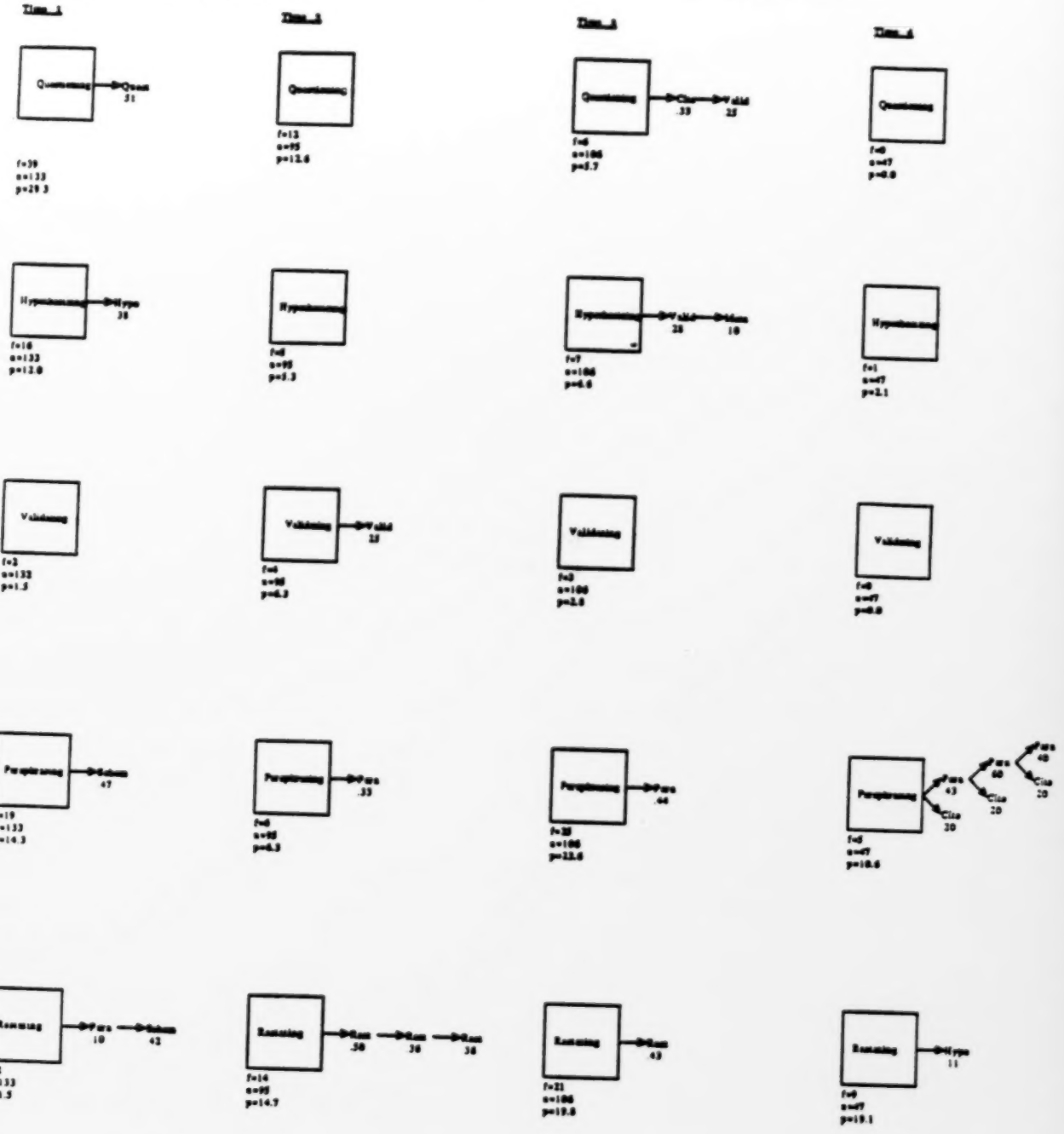


Figure 5
What Happens to Subsequent to Specific Reasoning Operations Over Time (Lisa)
Percent of Thought Units



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